Clinical outcomes in hypertensive patients undergoing bariartic surgery

Eurasian Clinical and Analytical Medicine Original Research

Bariatric surgery and HT patients

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Abstract

Aim: This study aimed to investigate the impact of bariatric surgery (BS) on individuals with hypertension (HT) by assessing changes in clinical and metabolic parameters following BS.

Material and Methods: A total of 34 obese individuals undergoing BS were included in the study. Demographic characteristics, including age and gender, were recorded, along with clinical parameters such as body mass index (BMI), glucose levels, blood urea nitrogen (BUN), uric acid, C-reactive protein (CRP), albumin, CRP-to-albumin ratio (CAR), and glycated hemoglobin (HbA1c). Hypertensive patients were further divided into groups based on the use of HT medication. Changes in these parameters were assessed three months post-surgery and compared between groups.

Results: No significant differences were observed in age, gender, and most metabolic parameters between groups with and without HT (p>0.05). Although, preoperative BMI was higher in the HT group (p=0.014), the difference was decreased following BS (p=0.059). 29.2% of HT patients stopped or reduced doses of antihypertensive medicines. There were no significant differences in glucose, BUN, CRP, CAR, and HbA1c levels between groups. Notably, uric acid levels exhibited a greater reduction in the HT group (mean change of -0.3 vs. -0.1, p=0.026). AKI rates were higher among HT patients with obesity (20% vs 12.5%, p=0.975) but the difference was not significant.

Discussion: This study has once again demonstrated that a reduction in blood pressure can be achieved in obese patients with HT following BS. Additionally, it is noteworthy that additional benefits, such as improvements in high uric acid levels in HT patients, can also be observed. These findings reflect the beneficial metabolic consequences of BS.

Keywords

Bariatric Surgery, Hypertension, Obesity, Metabolic Changes, Uric Acid

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Introduction

A body mass index (BMI) of ≥30 kg/m^2 denotes obesity, a chronic condition on the rise globally [1,2]. The World Health Organization estimates around 650 million adults worldwide suffer from obesity (availiable at: https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight), with approximately 35% of U.S. adults (about 100 million people) affected [3]. Procedures addressing obesity are collectively known as metabolic or "bariatric" surgery (from the Greek "baros," meaning "weight," and "iatrikos," meaning "medicine"). Obesity has long been associated with increased morbidity and mortality, particularly reducing life expectancy for those under 40 years old [4]. Higher BMI generally correlates with elevated all-cause and cardiovascular mortality risk, with a 21-108% increased risk in all-cause mortality among those with BMI ≥30 according to a National Health Interview Survey analysis [5]. The risk escalates with higher BMI and is more pronounced in severe obesity. Bariatric surgery (BS), or metabolic surgery, is increasingly employed worldwide, particularly for advanced obesity. It 'is preferred for patients who meet these criteria: 1) BMI ≥ 40 kg/m^2, 2) BMI ≥ 35 with obesity-related comorbidities (e.g., type 2 diabetes, hypertension), and 3) unsuccessful weight loss despite medical efforts [6].

Obese individuals frequently exhibit elevated blood pressure, especially with upper body and abdominal obesity. Weight loss in obesity is linked to lower blood pressure. Bariatric surgery not only improves metabolism, including diabetes and fatty liver disease, but also reduces blood pressure [7,8]. This study aims to reveal the differences between outcomes of hypertensive and nonhypertensive individuals following sleeve gastrectomy.

Material and Methods

In this retrospective two-center case- control study, 34 individuals with obesity who underwent sleeve gastrectomy between January 27 and February 28, 2022, were evaluated. The operations were conducted at Medicana International Ankara hospital by experienced bariatric surgery teams who currently operates monthly approximately 20-25 cases.

Inclusion criteria: Individuals with bariatrric surgery indications and who could be completely monitored in regardfor of clinical and laboratory features following sleeve gastrectomy were enrolled in the study.

Exclusion criteria: Prolonged hospitalization, post-surgery infection, and patients with missing data.

BS indications: The indications were followed according to the criteria of the American Society for Metabolic and Bariatric Surgery 2018 [6].

Drug cessation and categorizing: Individuals who were under an antihypertensive regimen longer than 3 months were labelled as hypertensive "HT + Group" and who had no history of HT were labelled as "HT – Group". Then, after BS surgery, a group of patients who did not require antihypertensive following 3 months were labelled as "hypertensive medication -" and the patients who remained on anti-hypertensive medication were labelled as "hypertensive medication +" groups. Furthermore, patients who required a lower dose of antihypertensive medication postoperatively compared to their preoperative dose were categorized into the 'HT -' and 'hypertensive medication -' groups.

Measurements: The demographic variables (age, gender, BMI) and laboratory features (glucose, creatinine, uric acid, C-reactive protein [CRP], albumin, CRP-to-albumin ratio [CAR], glycated hemoglobin A1c [HbA1c]) of patients were recorded preoperatively and at 3 months after post-bariatric surgery (BS).

Ethics Committee Approval: The study was conducted in accordance with the Declaration of Helsinki and after was approvedal of by the Research Ethics Committee of Medipol University Faculty of Medicine (IRB no: E-10840098-772.02-6203). Because of the design of the study, informed consent was not required.

Statistical Analysis

Research data were analyzsed using IBM SPSS 22 (IBM Statistical Package for Social Sciences). Descriptive statistics of categorical variables are presented as numbers and percentages. The normality distribution of numerical variables was assessed with the Shapiro-Wilk test because the number of cases per group was less than 30. Cross-tabulations were used to compare categorical variables, and the Pearson chi-square test, Yates continuity correction, and Fisher exact test were applied. Numeric variables, which were normally distributed (parametric) were presented as mean ± standardt deviation, and numeric variables, which were not normally distributed (nonparametric) were variables are presented as median (minimum-maximum). The independent -samples t- test was used in the comparison for parametric variables, whereas the Mann-Whitney U test was used in the comparison of non- parametric variables. The accepted statistical significance level was $p<0.05$.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

The study included a total of 34 obese individuals. 70.5% of obese patients in this study had HT. Table 1 presents the demographic and laboratory characteristics of the groups based on the presence of hypertension (HT) among the participants. Regarding age and gender, no differences were observed between the groups with and without HT. While there were no disparities between the groups concerning the patients' preoperative BMI, a significant difference in mean BMI was

Table 1. Comparison of demographic and clinical-laboratory results betweenamong groups based on hypertension the presence of hypertension.

	HT (-) (n=10)	HT (+) (n=24)	P
Age	34.5±7.6	39.2±11.4	0.2411
Gender, f/m (f%)	6/4 (60%)	16/8 (66.7%)	0.7142
BMI at surgery time, kg/m^2	39.9±3.3	44.7±7.3	0.0141
BMI at 3 months	31.6 (29-44)	35.6 (28-52)	0.0593
Glucose at surgery time, mg/dl	99 (83-173)	103 (84-341)	0.3343
Glucose at 3 months, mg/dl	95 (82-125)	97 (81-180)	0.8483
BUN at surgery time, mg/dl	13 (10-26)	12 (6-29)	0.3343
BUN at 3 months, mg/dl	11.9±2	11.5±2.3	0.7161
Uric acid at surgery time, mg/dl	5.1±1.5	5.7±1.3	0.3171
Uric acid at 3 months, mg/dl	4.9±1.3	5.2±0.9	0.4271
CRP at surgery time, IU/L	5 (1.3-31)	7 (2.2-21)	0.3953
CRP at 3 months,IU/L	5±3.9	3.1±1.3	0.2881
Albumin at surgery time, g/dl	4.6 (3.7-4.7)	4.5 (3.5-5.4)	0.7173
Albumin at 3 months, g/dl	4.2±0.2	4.2±0.2	0.7951
CAR at surgery time	1.1 (0.3-7.1)	1.6 (0.5-5.4)	0.4603
CAR at 3 months	1.2±1	0.7±0.3	0.3041
Hba1C% at surgery time	5.7 (4.4-7.7)	5.9 (5.2-12.5)	0.2533
Hba1C% at 3 months	5.5 (4.4-7.1)	5.5 (5.1-9.2)	0.4173
AKI, y/n (y%)	2/8 (20%)	3/21 (12.5%)	0.9754

[1]Independent sample-t test [2]Fisher Exact test [3]Mann- Whitney -U test [4]Yates Continuity correction

Table 2. Differences in of patient's clinical and laboaraotary characteristics between preoperative and postoperative -3 -months.

	HT (-) (n=10)	HT (+) (n=24)	P
BMI difference at 3 months according to surgery time, kg/m^2	-6.6±1.7	-7.5±1.6	0.1381
Glucose difference at 3 months according to surgery time, mg/dl	-4.5 (-48 – +2)	-10 (-161 – +2)	0.0942
BUN difference at 3 months according to surgery time, mg/dl	-1.7 (-11.5 – +1.6)	-0.95 (-15 – +4.8)	0.4042
Uric acid difference at 3 months according to surgery time, mg/dl	-0.15 (-0.8 – +0.1)	-0.2 (-1.8 – +0.4)	0.4802
CRP difference at 3 months according to surgery time, IU/L	-0.7 (-20.3 – +1.2)	-3.6 (-18 – +1.6)	0.1262
Albumin difference at 3 months according to surgery time, g/dl	-0.23±0.22	-0.25±0.37	0.9431
CAR difference at 3 months according to surgery time	-0.15 (-4.6 – +0.3)	-0.72 (-4.8 – +0.4)	0.1122
Hba1C% difference at 3 months according to surgery time	-0.1 (-0.6 – +0.1)	-0.3 (-3.3 – 0)	0.0382

[1]Independent sample-t test [2]Mann- Whitney -U test
BMI, Body mass index BUN, Bloodd urea nitrogen, CRP, C-reactive protein CAR, CRP to albumin ratio

Table 3. Demographic characteristics and the characteristics of the patients who did not require hypertension medication and whose continued hypertension treatment.

	Hypertensive medication (-) (n=7)	Hypertensive medication (+) (n=17)	P
Age	44±16.2	37±8.5	0.3021
Gender, f/m (f%)	6/1 (85.7%)	10/7 (58.8%)	0.4272
BMI at surgery time, kg/m^2	49 (37-58)	42.8 (35-61)	0.7573
BMI at 3 months	39 (31-48)	35.4 (28-52)	0.6643
Glucose at surgery time, mg/dl	103 (87-341)	102 (84-2121)	0.8043
Glucose at 3 months, mg/dl	98 (86-180)	95 (81-176)	0.7103
BUN at surgery time, mg/dl	12 (11-14)	12 (6-29)	13
BUN at 3 months, mg/dl	11.9±2.6	11.4±2.2	0.6311
Uric acid at surgery time, mg/dl	4.9±0.7	6.1±1.5	0.0741
Uric acid at 3 months, mg/dl	4.8±0.6	5.5±.09	0.1311
CRP at surgery time, IU/L	7 (2.2-21)	7.1 (2.8-18)	0.9453
CRP at 3 months, IU/L	3.7±1	2.7±1.4	0.1201
Albumin at surgery time, g/dl	4.3±0.3	4.5±0.3	0.3881
Albumin at 3 months, g/dl	4.1 (4-4.8)	4.2 (3.9-4.6)	0.9013
CAR at surgery time	1.6 (0.5-5.4)	1.6 (0.6-3.9)	0.8373
CAR at 3 months	0.9±0.3	0.7±0.34	0.1421
Hba1C% at surgery time	6.2 (5.3-12.5)	5.9 (5.2-11.5)	0.6193
Hba1C% at 3 months	5.8 (5.3-9.2)	5.5 (5.1-8.9)	0.3833
AKI, y/n (y%)	4/3 (42.9%)	17/0 (0%)	0.0272

[1]Independent sample-t test [2]Yates Continuity correction [3]Mann- Whitney -U test
BMI, Body mass index BUN, Bloodd urea nitrogen, CRP, C-reactive protein CAR, CRP to albumin ratio

detected after three months, with the HT group showing a higher mean BMI (31.6 kg/m² vs. 44.7 kg/m², p = 0.014).

During the preoperative assessment, no statistically significant differences were found between the groups in terms of glucose, BUN, uric acid, CRP, albumin, CAR, and HbA1c levels. Similarly, at the three-month follow-up after surgery, no statistically significant differences were identified between the groups in relation to glucose, BUN, uric acid, CRP, albumin, CAR, and HbA1c levels. Additionally, no statistically significant differences were observed between the groups in terms of the development of acute kidney injury (AKI).

BMI, Body mass index BUN, Bloodd urea nitrogen, CRP, C-reactive protein CAR, CRP to albumin ratio.

According to the presence of hypertension, differences in patients' BMI, glucose, BUN, uric acid, CRP, albumin, CAR, and HbA1c values were assessed at the three-month mark post-bariatric surgery in comparison to their respective preoperative values (see Table 2). No statistically significant differences were observed between the groups in terms of BMI, glucose, BUN, uric acid, CRP, albumin, and CAR. However, there was a higher change in HbA1c levels in the HT group when compared to the group without HT (median change of -0.3 vs. -0.1, p=0.038).

A subset of patients with hypertension (n=7, 29.2%) no longer required hypertension medication following bariatric surgery. In Table 3, we present the characteristics of patients who ceased hypertension medication and those who continued their treatment. Notably, no statistically significant differences were observed between the groups concerning age, gender, preoperative and postoperative BMI, glucose, BUN, uric acid, CRP, albumin, CAR, and HbA1C. Four patients who developed acute kidney injury (AKI) belonged to the group that discontinued hypertension treatment (p=0.027). This is probably due to postoperative hypotension episodes which did were mandatory to stop the medication.

In the context of the HT medication (-)/(+) groups, variations in patients' BMI, glucose, BUN, uric acid, CRP, albumin, CAR, and HbA1c values were assessed at the three-month mark post-bariatric surgery in comparison to their respective preoperative values, and the groups were subjected to comparative analysis. No statistically significant differences were observed between the groups concerning BMI, glucose, BUN, CRP, CAR, and HbA1c (respectively, p=0.173, p=0.852, p=0.534, p=0.407, p=0.266, p=0.447, p=0.534). However, a significant discrepancy emerged in the reduction of uric acid levels between the group receiving hypertension treatment after bariatric surgery and the group not receiving any medication (mean change of -0.3 vs. -0.1, p=0.026).

Discussion

The present study investigated the impact of bariatric surgery on individuals with hypertension. The findings revealed significant changes in various clinical parameters post-surgery. Notably, a subgroup of patients with HT demonstrated a notable decrease in the need for HT medication following bariatric intervention, underscoring the potential therapeutic benefits of surgical intervention in managing HT.

Hypertension and obesity are the main risk factors for mortality and cardiovascular diseases [9,10]. The relationship between excess adiposity and elevated blood pressure is well-established, with obesity estimated to account for 65-78% of cases of primary hypertension [11]. Consistent with previous studies, this research found a hypertension prevalence rate as high as 70.5% among obese patients. Furthermore, this study focused on a relatively young population with a higher prevalence of hypertension. However, it is evident that this population represents a group of patients with at least Class II obesity or Class I obesity accompanied by comorbidities.

Bariatric surgery is the preferred treatment option for obesity in a group of patients whose criteria are outlined in the guidelines [6]. Additionally, since many metabolic parameters reverse following bariatric surgery, a reduction in blood pressure can also occur [12,13]. Patients diagnosed with hypertension before undergoing bariatric surgery had higher BMI values. However, after sleeve gastrectomy, the BMI values of patients with and without a diagnosis of hypertension were found to be similar. Remarkably, 29.2% of patients diagnosed with hypertension before the surgery achieved normotension within the first three months postoperatively, leading to the discontinuation of their antihypertensive medications. Indeed, a group of patients, likely because they did not discontinue antihypertensive medications in the preoperative period, experienced acute kidney injury related to hypotension. As a result, antihypertensive medications had to be discontinued early in these patients. Uric acid levels exhibited a more pronounced decrease in the HT group following BS. The reduction in uric acid levels in the HT group may signify a favorable metabolic response to BS, which could have implications for the management of both hypertension and hyperuricemia in obese individuals. The findings of from this study align with the research conducted by Liu et al., which reported the effectiveness of bariatric surgery in reducing serum uric acid levels in obese patients with type 2 diabetes mellitus [14]. Analysis of metabolic and inflammatory markers provided valuable insights into the physiological shifts accompanying BS. Notably, no statistically significant variances were detected in glucose, blood urea nitrogen, C-reactive protein, albumin, CAR, and HbA1c levels between HT groups. This suggests that, within the scope of this study, HT did not exert a discernible influence on these parametres post-BS.

Limitations of The Study

1. Short-Term Follow-Up: The study's follow-up period was limited to three months post-bariatric surgery. Longer-term follow-up would provide a more comprehensive understanding of the sustained effects of surgery on hypertension and other metabolic parameters.
2. Selection Bias: The study may be susceptible to selection bias, as the sample consisted of individuals who had already opted for BS. This may not represent the entire population of individuals with obesity and hypertension, potentially skewing the results.
3. Lack of Control Group: The absence of a control group, comprising obese individuals who did not undergo bariatric surgery, makes it challenging to attribute observed changes solely to the surgical intervention.
4. Data on Medication Use: While the study mentions the discontinuation of hypertension medication in some patients, detailed information on medication types, dosages, and adherence would provide a more nuanced understanding of the impact of surgery on medication management.
5. Heterogeneity: The study does not address potential variations in surgical techniques or the presence of other comorbidities among the participants, which could influence outcomes.
6. Data on Dietary and Lifestyle Changes: Information regarding dietary and lifestyle modifications following surgery, which can significantly affect metabolic parameters, was not included in the analysis.
7. Single-Center Study: The study's single-center nature of the study may limit the generalizability of the findings to other healthcare settings with different patient demographics and practices.
8. Data Collection Methods: The study relies on retrospective data, which may introduce recall bias and limit the accuracy of certain clinical measurements.
9. Duration of Hypertension: The duration of hypertension and its management prior to surgery were not explicitly considered in the analysis, which could impact the observed changes in HT status post-surgery.
10. Statistical Power: Given the small sample size, the study may have limited statistical power to detect subtle differences in some parameters, potentially leading to type II errors.ot exert a discernible influence on these parameters post-BS.
11. Sample Size: The study included a relatively small sample size of 34 obese individuals, which may limit the generalizability of the findings to broader populations.

Conclusion

This study provides valuable insights into the effects of bariatric surgery on individuals with hypertension. While no significant differences were observed in several clinical parameters, a notable reduction in uric acid levels was noted in patients receiving HT medication post-surgery. Additionally, close monitoring of renal function is crucial, especially in individuals receiving HT treatment. Further research, encompassing larger sample sizes and longer follow-up periods, is warranted to corroborate these findings and illuminate the intricate interplay between HT, bariatric surgery, and associated metabolic changes. These insights hold the potential for refining therapeutic approaches and optimizing outcomes for individuals with both obesity and hypertension.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of Interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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